UNITED STATES OF AMERICA

1.Criminal No. WDQ-08-086

Plaintiff, *

e. *

TAVON MOUZONE, *

Defendant. *

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**REPORT AND RECOMMENDATION**

On February 21, 2008, Defendants Tavon Mouzone, Anthony Fleming, Sherman Pride, Keili Dyson, Ronnie Thomas, and Jerrod Fenwick were indicted on charges of violating 18 U.S.C. § 1962(d), Conspiracy to Participate in a Racketeering Enterprise.[1] Paper No. 1. Alleged involvement in homicides underlay the Defendants' charges. *Id.*

On August 10, 2009, Defendant Mouzone filed a Motion to Suppress Firearms Identification on the Basis of Scientific Invalidity ("Def.'s R. 702 Mot."), Paper No. 566, and a Motion to Suppress Firearms Identification ("Def.'s R. 16 Mot."), Paper No. 565. In addition, on September 24, 2009, he filed a Supplementary Affidavit in Support of Defendant Mouzone's Motion to Suppress Firearms Identification of the Basis of Scientific Invalidity and Motion to Suppress Firearms Identification, , and an Affidavit of Adina Schwartz ("Aff."). Paper Nos. 639, 639-1, & 639-2. To the Affidavit, Professor Schwartz attached Sergeant Mark K. Ensor's

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1 Defendants Fleming, Dyson, Pride, and Fenwick were also indicted on other charges not relevant to this Report and Recommendation. Paper No. 1.

laboratory reports of August 10, 2007 ("Report 1"); September 27, 2007 ("Report 2"); and July 23, 2008 ("Report 3").[2] Aff., Exs. A-C; Paper Nos. 639-3 – 639-5.

On August 13, 2009, Defendant Anthony Fleming filed a Motion to Adopt Motion to Suppress Firearms Expert Testimony, Paper No. 571, and on October 10, 2009, Defendant Fleming filed a Motion to Adopt and Join Motion to Suppress Firearms Testimony, Paper No. 657, which Judge Quarles granted on October 14, 2009, Paper No. 663. On October 16, 2009, the Government filed the Government's Memorandum of Law in Opposition to Defendant Tavon Mouzone's Motion to Suppress Firearms Identification on the Basis of Scientific Invalidity.[3]Paper No. 676. On October 21, 2009, Defendant Mouzone filed his Response to Government's Reply to Defendant's Motion to Suppress Firearms Identification. Paper No. 689. Additionally, Judge Quarles issued an order, Paper No. 688, on October 21, 2009, permitting any other codefendant to join in Mouzone's motion. Defendants Sherman Pride, Keili Dyson, Ronnie Thomas, and Jerrod Fenwick did so.[4] Paper Nos. 679, 681, 684, 690.

On October 9, 2009, and October 16, 2009, in accordance with 28 U.S.C. § 636 and Local Rules 301 and 302, Judge Quarles referred this case to me to conduct a hearing and prepare a

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[2] As discussed in further detail *infra*, Sgt. Ensor is a firearms examiner in the Firearms Identification Unit of the Forensic Services Section of the Baltimore County Police Department.

[3] On October 9, 2009, the Court ordered that any opposition memorandum be filed by close of business on October 14, 2009. Paper No. 660. And, on October 15, 2009, the Court granted the Government's October 14, 2009 request to extend the deadline to October 16, 2009 (Paper No. 668). Paper No. 671.

[4] For ease of understanding in this Report and Recommendation, I shall refer solely to Defendant Mouzone's motions. These references are meant to include the arguments adopted by Mouzone's co-defendants as well.

Report and Recommendation with regard to these motions to suppress evidence. Paper Nos. 655 & 678. For the reasons stated herein, I recommend that Defendant Mouzone's motion be GRANTED IN PART and DENIED IN PART and, if adopted by Judge Quarles, this Report and Recommendation will address the same issues adopted by all co-defendants who joined in Mouzone's motion. This Report and Recommendation addresses Paper Nos. 565, 566, 571, 639, 657, 676, and 689, as well as Paper Nos. 679, 681, 684, and 690, to the extent they pertain to Defendant Mouzone's motions.

## I. Defendant Mouzone's Rule 702 Motion

As noted, the Defendant Mouzone's charges stem from the allegation that he participated in two homicides, one of which occurred on November 17, 2006, on Streeper Street in Baltimore City, and the other of which occurred on December 17, 2006, on Rumelia Circle in Essex, Baltimore County, Maryland. Def.'s R. 16 Mot. ¶ 1. The Government informed the Defendant that "a Baltimore County firearms examiner . . . concluded that a "match" exists between the cartridge casings found at the two scenes." *Id.* ¶ 2.

Anticipating that "the government will wish to introduce this testimony to a reasonable degree of scientific certainty,"[5] Defendant Mouzone contends that such testimony is inadmissible

[5] At a hearing held October 26, 2009, the Government stated that it sought to introduce this testimony "to a reasonable degree of technical certainty." Hr'g Tr. 10/26/09.

Because the trial is starting in less than a week and the transcript is not yet available for specific page references, this Report and Recommendation refers generally to the hearing transcript.

under Fed. R. Evid. 702 because "comparisons of cartridge casing-to-cartridge casing are unreliable" and "scientifically invalid." Def.'s R. 702 Mot. ¶¶ 4, 8-9. Defendant Mouzone's objections to the evidence appear in Professor Schwartz's Affidavit. Paper No. 639-2. Professor Schwartz is a Professor at John Jay College of Criminal Justice and The Graduate Center, City University of New York, and she has testified at hearings and provided affidavits in numerous cases addressing this issue.[6] E.g., *United States v. Taylor,* No. CR 07-1244, 2009 WL 3347485 (D.N.M. Oct. 9, 2009); *United States v. Glynn*, 578 F. Supp. 2d 567 (S.D.N.Y. 2008); *United States v. Diaz*, No. 05-167, 2007 WL 485967 (N.D. Cal. Feb. 12, 2007) (unpublished); *United States v. Monteiro*, 407 F. Supp. 2d 351 (D. Mass. 2006). The Affidavit challenges the admissibility of firearm toolmark identification evidence in general and the admissibility of the findings and opinions of Baltimore County firearms examiner Sergeant Mark Ensor in particular. Aff. 4-49. Professor Schwartz asserts in her affidavit:

1. The assumption that firearm toolmarks are unique and reproducible "has not yet been fully demonstrated." Aff. 7, ¶ 9.

2. Even if the required research were done, and it showed that firearm toolmarks were unique and reproducible, that still would not be sufficient to make toolmark identification a "science" because toolmark examiners have no reliable methods for determining whether different toolmarks were created by the same weapon. Aff. 9, ¶ 10.

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[6] Although a prolific critic of firearm toolmark identification methodology, and a peripatetic defense witness, Professor Schwartz is not herself a firearms toolmark examiner. *United States v. Monteiro*, 407 F. Supp. 2d 351, 367 (D. Mass. 2006).

3. Toolmark identification methods are unreliable because toolmark examiners are unable to isolate and identify toolmarks with individual characteristics from those with class or subclass characteristics. Aff. 10-11, ¶¶ 11-12.

4. There are three major difficulties preventing the reliable identification of "one and only one" weapon as the source of a specific toolmark. Aff. 12, ¶ 14.

5. The first difficulty is the practice of referring to different, overlapping types of marks as "individual characteristics." For example, sometimes the term "individual characteristics" is used to refer collectively to the microscopic markings that comprise a unique toolmark; at other times "individual characteristics" is used to refer to the individual components that, while not unique to any one tool, come together to comprise an allegedly unique toolmark. Aff. 12, ¶ 14.

6. The second difficulty is that misidentifications occur when an examiner presumes that the resemblance between the non-unique, overlapping, individual marks of the test and evidence toolmarks is proof that the toolmarks were produced by the same weapon, when such resemblance is possible in marks made by different weapons. Aff. 13, ¶ 15.

7. The third difficulty is that toolmarks produced by the same tool are not always the same. Aff. 15, ¶ 17.

8. A toolmark can change overtime as the surface of an individual tool changes due to use, damage, and corrosion. Aff. 16, ¶ 17.

9. As a result, sometimes differences in toolmarks are correctly attributed to changes in the surfaces of a particular tool. At other times such a conclusion is wrong,

such as when differences in toolmarks exist because the marks were made by different, albeit very similar, tools. Aff. 18, ¶ 18.

10. Differences in toolmarks made by the same tool may also occur because the "pressure and velocity involved" when the tool and ammunition interact at firing "are subject to intrinsic variation from shot to shot." Aff. 17, ¶ 17.

11. Subclass characteristics that are made by more than one tool, such as microscopic striations on bullets, may be confused with individual characteristics that can be created by one and only one tool. Aff. 19, ¶ 19.

12. As the manufacturing process continues to improve, the shared subclass characteristics of large numbers of weapons will increase the risk of misidentifications. Aff. 23, ¶ 22.

13. Presently, no "strict rules" exist for determining whether a toolmark is made by a subclass or individual characteristic. Aff. 21, ¶ 20.

14. Moreover, notwithstanding the "rules of thumb" present in some publications, there exists no authoritative guidance regarding which tools or manufacturing processes produce tools that create toolmarks with subclass characteristics; instead, examiners rely on their personal familiarity and experience with various tools, finishes, and forming. Aff. 21, ¶ 20.

15. There is an even greater risk of confusing these two classes of characteristics when an examiner compares toolmarks from various component parts of ammunition to determine whether they were produced by the same gun. Aff. 22, ¶ 21.

16. Because of the difficulties associated with reliably identifying whether a

particular toolmark has been created by a specific weapon, especially when toolmarks from different weapons are sometimes very similar, and toolmarks from the same weapon are occasionally somewhat different, identifications are naturally probabilistic. Aff. 24, ¶ 23.

17. The necessary empirical and statistical work required to overcome the unreliability of the methods presently used has yet to be done. Aff. 26, ¶ 25; Aff. 27 ¶ 26.

18. Examiners are unable to articulate the criteria upon which they base their conclusions; they rely instead on their experience, making each identification a subjective determination. Aff. 26, ¶ 25.

19. Toolmark examiners may disagree with each other if they are applying different criteria for concluding that a match exists. Aff. 35, ¶ 37.

20. The same toolmark examiner might even reach different conclusions in a particular case over time by applying different "mind's eye identification criteria" to the same evidence. Aff. 35, ¶ 37.

21. Many examiners are not trained scientists, but rather technicians; therefore, they do not understand empirical and statistical studies regarding firearm toolmarks and the probabilities regarding the likelihood that another firearm could have made the toolmarks observed. Aff. 35, ¶ 36.

22. The Association of Firearm and Tool Mark Examiners ("AFTE")[7] theory of firearm toolmark identification provides no "objective guidance" regarding when an examiner should declare a match. Aff. 28, ¶ 27.

[7] AFTE is the leading proponent of the theory of firearms toolmark identification followed by the vast majority of examiners.

23. Examiners in different parts of the United States, based on their various experiences with differing weapons, will likely arrive at different conclusions regarding identifications. Aff. 29, ¶ 27.

24. Some examiners, but not a majority of them, rather than using the wholly subjective approach, employ the consecutive matching striae ("CMS") criteria when attempting to identify toolmarks. Aff. 29, ¶ 28.

25. CMS, though better than the traditional subjective approach to toolmark identification, is nonetheless a "highly imperfect attempt to incorporate statistical empirical data into toolmark identifications." Aff. 32, ¶ 32.

26. There are questions regarding whether the CMS criteria were derived from databases that are relevant to and representative of firearm toolmarks. Aff. 33, ¶ 34.

27. CMS may not be a more objective method of toolmark identification, but rather a way for examiners to describe their subjective observations when comparing striated toolmarks. Aff. 31, ¶ 30.

28. Some argue that CMS is a subjective process because it essentially amounts to line-counting. Aff. 33, ¶ 34.

29. CMS applies only to striated toolmarks, and not to breech face marks or firing pin impressions, and only to individual, as opposed to subclass, characteristics. Aff. 32, ¶ 33.

30. Misapplication of the CMS criteria may result in misidentifications. Aff.

33, ¶ 33.

31. Without objective, strict criteria for determining whether toolmark identifications are correct in a given case, it is impossible to calculate an error rate for the discipline of firearm toolmark identifications . Aff. 36, ¶ 38.

32. The only widely used proficiency tests for firearm toolmark examiners, the Collaborative Testing Services ("CTS") tests, cannot provide an accurate error rate because the tests are declared, as opposed to blind, thereby introducing the potential for bias, and the proficiency test problems are simpler than the "real" firearm toolmark identifications the examiners encounter in actual cases. Aff. 37, ¶ 39.

33. Because the only firearm the examiner is given is the one believed to be evidence of a crime, confirmation bias also undermines the validity of toolmark identifications. Aff. 40, ¶ 41.

34. Bias also can play a role in identifications if peer review of the original examiner's work is performed only when identifications are reached. Aff. 41, ¶ 41.

35. Because examiners work closely with law enforcement and prosecution, bias can affect the examiners' conclusions. Aff. 41, ¶ 42

36. Scrutiny by the scientific community at large might resolve some of the problems surrounding toolmark identification, but access to firearm toolmark publications is not largely accessible. Aff. 42, ¶ 43.

37. Many articles published in the *AFTE Journal* are not available on-line to the public, even those willing to pay for it. On-line access is limited to AFTE members, who must be practicing or students in the field of firearm toolmarks, and to honorary

members. Non-members may access hard copies of the *AFTE Journal*, but it is only available at one school on the West Coast, and two on the East Coast. Aff. 42-43, ¶ 43.

38. The specific procedures in this case departed greatly from the widely accepted practices within the field. Aff. 43, ¶ 44.

39. Sgt. Ensor failed to provide the documentation in support of his conclusions that would make possible any meaningful peer review. Aff. 43, ¶ 44.

40. The three laboratory reports list "multiple, bare bones cartridge case and bullet identification conclusions," but fail to include "bench notes, diagrams, photomicrographs or narrative descriptions" as to how the conclusions were reached. Aff. 46, ¶ 44.

41. The lack of documentation makes it impossible to determine the types of toolmarks upon which the conclusions were based; the particular lands or grooves on the various bullets on which the identifications were based; the extent of the resemblances and differences between the toolmarks found on the various bullets and casings; whether and how the toolmarks were differentiated by class, subclass, and individual characteristics; and what criteria he relied upon in determining whether the resemblances were sufficient to support his conclusions. Aff. 46, ¶ 45.

42. Nothing in the documentation explains why or how Sgt. Ensor came to different conclusions on different dates, August 10, 2007 and September 27, 2007, regarding the same cartridge cases. Aff. 46, ¶ 45.

43. The only evidence of any peer review performed on Sgt. Ensor's work is the signature of one other officer on the August 10, 2007 report. There exists no evidence

that either the July 23, 2008 laboratory report, or the September 27, 2007 report was ever peer reviewed. Aff. 48, ¶ 46.

44. The peer review of the August 10, 2007 report did nothing to correct Sgt. Ensor's failure to document the reasons for his conclusions, and there is no indication that the peer review was blind. Aff. 48, ¶ 46.

45. Because only one individual peer reviewed Sgt. Ensor's laboratory report, the laboratory failed to follow operating procedures that provide that peer review should be performed "by a minimum of two personnel."

Professor Schwartz testified during the hearing held October 26, 2009, and her testimony was consistent with her Affidavit, though it referred to additional reference materials. Hr'g Tr. 10/26/09. While her Affidavit, which preceded the Defense's receipt of the underlying documentation from the Government, addressed the deficiencies in Sgt. Ensor's methodology, her testimony focused on the unreliability of firearm toolmark identification in general.

The Government contends that the Court should deny Defendant Mouzone's motion and "allow the government's firearms experts to state their opinions as they wish," because it would be "consistent with the weight of authority . . . to allow the government's firearms identification witness to state an opinion to a reasonable degree of ballistic certainty . . . ." Gov.'s Opp'n 1, 5. The Government contends that its experts "have extensive professional and training qualifications, work in labs with thorough peer review, and maintained notes and reports concerning their findings." Gov.'s Opp'n 4 n.3. The Government also filed a motion on October 23, 2009, seeking to disqualify Professor Schwartz from testifying. Paper No. 695. Defendant Mouzone has not had an opportunity

to file an opposition. However, as I stated at the hearing, this motion has not been referred to me for a report and recommendation, and is not directly addressed herein. Hr'g Tr. 10/26/09.

The hearing was held on October 26, 2009. Sgt. Ensor testified as a witness for the Government, and Professor Schwartz testified for the defense. Hr'g Tr. 10/26/09. On October 23, 2009, Defendant Mouzone had filed documents in anticipation of the hearing, including NATIONAL RESEARCH COUNCIL'S COMMITTEE ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIENCES COMMUNITY, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD 85-110, 127-82 (National Academies Press 2009) ("NRC Forensic Science Report");[8]Adina Schwartz, *A Systemic Challenge to the Reliability and Admissibility of Firearms and Toolmark Identification*, 6 COLUM. SCI. & TECH. L. REV. 2 (2005) ("Schwartz"); Alfred Biasotti, John Murdock, & Bruce R. Moran, *Scientific Issues*, *in* 4 MODERN SCIENTIFIC EVIDENCE 592 627 (2008-09); M.S. Bonfanti & J. De Kinder, *The influence of manufacturing processes on the identification of bullets and cartridge cases—a review of the literature*, SCIENCE & JUSTICE 39(1): 3-10 (1999) ("Bonfanti"); and Professor Schwartz's curriculum vitae. Paper No. 694, Ex. 1, 4-8 (Paper Nos. 694-2, 694-5 – 694-9). The Defense also submitted a series of additional exhibits at the hearing, including: Alfred A. Biasotti & John Murdock, *"Criteria for Identification" or "State of the Art" of Firearm and Toolmark Identification*, 16(4) AFTE JOURNAL 16-34 (1984), Ex. 4; *Standardization of Comparison Documentation*, 38(1)

[8] The National Research Council also published another report, BALLISTIC IMAGING (Nat'l Academies Press 2008), which is discussed *infra* and in *Glynn*, 578 F. Supp. 2d at 572 & nn.7-8, 573, 574. "NRC Forensic Science Report" refers to the 2009 report; "NRC Ballistic Imaging Report" refers to the 2008 report.

AFTE JOURNAL 72-73 (2006); and Detroit Police Department Firearms Unit: Preliminary Audit Findings as of September 23, 2008, Ex. 5. Despite the offering of these exhibits on the eve of the hearing and at the hearing, all were received as part of the record. Hr'g Tr. 10/26/09.

**A. Firearm Toolmark Identification Evidence**

The evidence that Defendant Mouzone seeks to suppress is expert testimony regarding identifications of toolmarks made by a firearm. A toolmark is a mark "generated when a hard object (tool) comes into contact with a relatively softer object," such as the marks that result "when the internal parts of a firearm make contact with the brass and lead that comprise ammunition." NRC Forensic Science Report at 150. A firearm's internal components include the barrel, the chamber, the breech face, the firing pin, the extractor, and the ejector, and these components have "'individual characteristics'" that result from manufacturing processes such as "'cutting, drilling, grinding, hand-filing, and, very occasionally, hand-polishing.'" *Monteiro*, 407 F. Supp. 2d at 359 (citation omitted). Most "individual characteristics" on a spent bullet stem from the process that renders a gun barrel from a piece of solid steel:

> A first step of the process, drilling, results in a comparatively rough hole of uniform diameter extending from one end of the barrel to the other. Next the barrel is bored with a reamer, designed to produce as smooth a surface as possible on the inside of the barrel. The interior surface or bore bears numerous scars and scratches from this drilling process; it is these random imperfections—more so than subsequent steps—that are said to account for individual characteristics on fired bullets.
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> Barrels [usually] are further subjected to a rifling process, creating a pattern of grooves on the inside the barrel.[9] . . . [T]he bullet impacts with the barrel rifling and is given a rotation . . . that gives the bullet a more direct flight. . . . The rifling may be created by forcing a carbide button through the reamed barrel; it is the normal wear on this button, as many riflings are performed, that is said to impart individual microscopic variability in markings in the barrel (along

with residual scars or imperfections from the original drilling).

NATIONAL RESEARCH COUNCIL'S COMMITTEE TO ASSESS THE FEASIBILITY, ACCURACY AND TECHNICAL CAPABILITY OF A NATIONAL BALLISTICS DATABASE, BALLISTIC IMAGING 31 (Nat'l Academies Press 2008) ("NRC Ballistic Imaging Report") (citations omitted).

The NRC Ballistic Imaging Report also defined the other components of a firearm and described their interactions with each other and the ammunition:

> The rear section (away from the muzzle) of the barrel bore is known as the chamber; it is designed and sized to fit a specific caliber of cartridge. The part of the firearm against which a cartridge sits when it is placed in the chamber is the breech, and the whole assembly may be referred to as the breechblock or breech bolt.
>
> The specific surface of the breech that makes contact with the base of the cartridge is the breech face . . . . The exact steps used to form the breech assembly can vary by manufacturer, and the breech face may vary in terms of the amount of filing or polishing done on it and whether any paint or other materials is applied to it. Basic filing can create gross striation marks in linear arrangements; in others, a rotary milling operation may be applied to the breech face surface, creating a pattern of concentric circles. These steps are crucial to the theory of firearms identification as it is random imperfections created in these machining and filing processes that is said to make the surface (and the negative impressions of said surface, left on fired cartridge casings) unique.
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> A hole drilled through the breech assembly holds the firing pin, a very hard steel rod that can be forced to protrude from the breech to strike the primer of a cartridge seated in the chamber. While most firing pins have a small rounded

[9] The raised surfaces between the "grooves" of a gun barrel are referred to as "lands." *Diaz*, 2007 WL 485967, at *1.

> end or nose, some have more distinctive shapes . . . . Firing pins are generally made on a standard screw machine. Like the breech face, the tip of the firing pin is subject to machining and filing steps that impart microscopic imperfections.
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> ● * *

> Both revolvers and pistols make use of an extractor, typically a small arm that fits over the rim of the cartridge. As the name implies, the extractor serves to pull a spent cartridge from the chamber so that a new cartridge can take its place. In a revolver, the extractor—which can remove all cartridges simultaneously by depressing the ejection rod (or extractor rod)—also has ratchet notches that advance the cylinder to the next chamber. In a semiautomatic pistol, however, the extractor removes the cartridge so that it makes contact with the ejector, typically a fixed protuberance that strikes the rim of the cartridge. Because these steps are performed very quickly, and with some speed and force, both the extractor and ejector mechanisms can leave marks on expended cartridge casings.

*Id.* at 32-35 (citations and internal cross references omitted).

To be sure, mass production of guns has replaced hand-manufacturing, and "guns are mass-produced with even greater precision." *Glynn*, 578 F. Supp. 2d at 572. Nonetheless, "the final step in production of most firearm parts requires some degree of hand-filing which imparts individual characteristics to the firearm part." *Monteiro*, 407 F. Supp. 2d at 359.

In *Monteiro*, Judge Saris explained how these components and their characteristics cause toolmarks on bullets and cartridge casings:

> When a round (a single "shot") of ammunition is fired from a particular firearm, the various components of the ammunition come into contact with the firearm at very high pressures. As a result, the individual markings on the firearm parts are transferred to the ammunition. The ammunition is composed primarily of the bullet and the cartridge case. The bullet is the missile-like component of the ammunition that is actually projected from the firearm, through the barrel, toward the target. . . . The cartridge case is the part of the ammunition situated behind the bullet containing the primer and propellant, the explosive mixture of chemicals that causes the bullet to be projected through the barrel. In the case of a semi-automatic handgun, once a round of ammunition is loaded into the chamber, and the gun is cocked, the shooter pulls the trigger, and the firing pin is released. The firing pin strikes the back of the cartridge case, igniting the primer in the ammunition, thus starting a chemical reaction, leading to
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> > the bullet being pushed down the barrel by the expanding gases. These gases also exert an equal and opposite force on the

> cartridge case which forces the slide and breechblock to the rear. This ejects the spent cartridge case through a port in the side, or occasionally top, of the slide.
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> During this process, which occurs in a fraction of a second, the cartridge case comes into contact with several parts of the firearm, most notably the firing pin, as explained above, and the breech face, a flat surface behind the cartridge case against which the cartridge case is pushed by the expanding gases. When the cartridge case is "slammed into the standing breech face," some of the individual toolmarks left on the breech face in the manufacturing process are replicated on the surface of the cartridge case. These toolmarks are referred to as "impressed" toolmarks. Other marks might be left on the ammunition when parts of the firearm, like the firing pin, the extractor, or the ejector, are moved across the cartridge case, and these are referred to as "striated" toolmarks.

*Id.* at 359-60 (citations omitted); *see Diaz*, 2007 WL 485967, at *1-2; NRC Ballistic Imaging Report at 30-51; BRIAN J. HEARD, HANDBOOK OF FIREARMS AND BALLISTICS 127 (1997). In addition, "the inner barrel of the gun imparts 'rifling' on the bullet." Specifically, the lands make "depressed 'land impressions'" and the grooves make "raised 'groove impressions.'" *Diaz*, 2007 WL 485967, at *1. And, there is a left or right "twist imparted on a bullet . . . , depending on the direction of the lands and grooves." *Id.*

Firearm toolmarks are associated with a weapon's class, subclass, and individual characteristics. *Monteiro*, 407 F. Supp. 2d at 360; NRC Forensic Science Report at 152. Class characteristics are "'family resemblances which will be present in all weapons of the same make and model.'" *Monteiro*, 407 F. Supp. 2d at 360. Examples of class characteristics include the bullet's weight and caliber; number and width of the lands and grooves in the gun's barrel; and the "twist" (direction of turn, i.e., clockwise or counterclockwise, of the rifling in the barrel). *Diaz*, 2007 WL 485967, at *2. Class characteristics that cause toolmarks on spent cartridge casings include the "caliber, type of breech face, and type of firing pin." *Id.* A breech face may be "parallel,

arched, smooth, granular, or circular," and a firing pin can leave an impression that is "circular, rectangular, [or] elliptical." *Id.*

Subclass characteristics "are 'produced incidental to manufacture' and 'can arise from a source which changes over time,' and therefore "may be present on a group of guns within a certain make or model, such as those manufactured at a particular time and place." *Monteiro*, 407 F. Supp. 2d at 360; *Diaz,* 2007 WL 485967, at *2; *see* NRC Ballistic Imaging Report, *supra*, at 58 (defining subclass characteristics as having three characteristics: they are "'[p]roduced incidental to manufacture'"; (2) "'they relate to a small group source,'" i.e., "'a subset of the class to which they belong'"; and (3) they "'[c]an arise from a source which changes over time'") (citation omitted). An example would include imperfections "on a rifling tool that imparts similar toolmarks on a number of barrels before being modified either through use or refinishing." Ronald G. Nichols, *Defending the Scientific Foundations of the Firearms and Tool Mark Identification Discipline: Responding to Recent Challenges*, 52 J. FORENSIC SCI. 586, 587 (2007) ("Nichols").

Individual characteristics are "'[r]andom imperfections produced during manufacture or caused by accidental damage . . . which are unique to that object and distinguish it from all others." *Monteiro*, 407 F. Supp. 2d at 360; *see Diaz*, 2007 WL 485967, at *2. However, non-unique marks may comprise individual characteristics, and wear and tear cause individual characteristics to change over time to some extent. *Monteiro*, 407 F. Supp. 2d at 360-61. Thus, the toolmarks made on a bullet or cartridge casing include marks imposed by all weapons of the make and model that fired the ammunition (class characteristics), marks common only to a subset

of that make and model (subclass characteristics), and marks unique to the weapon that fired the ammunition (individual characteristics). *Id.* Sgt. Ensor testified that firearms toolmark examiners will not declare a "match" based on class characteristics, and they endeavor not to make a match based on subclass characteristics. Instead, they seek to make a match only on individual characteristics.

At the base of firearms identification is the theory that, based on correspondence among toolmarks, a firearms examiner can discern matches among bullets, cartridge casings, and their weapon of origin "[b]y using a 'comparison microscope' to compare ammunition test-fired from a recovered gun with spent ammunition from a crime scene." *Monteiro*, 407 F. Supp. 2d at 359; *see Diaz*, 2007 WL 485967, at *3; NRC Forensic Science Report at 153; *see also Glynn*, 578 F. Supp. 2d at 572 ("Firearm and toolmark analysis rests on the twin assumptions that the surface contours of every gun are unique and that, every time that gun is fired, some of those unique markings, along with markings caused by the act of firing itself, are transferred to the shell casing and bullet, leaving distinctive patterns on each of them.").

Comparison microscope images of breech face and firing pin marks on a cartridge (l) and rifling marks on a bullet (r). Courtesy of Maine State Police Crime Lab.

The process for subjective traditional pattern matching—the pervasive method of ballistic toolmark analysis, *see Diaz*, 2007 WL 485967, at *9—is as follows:

> [A] firearms examiner presented with a handgun and spent cartridge cases will test fire the weapon using the same type of ammunition as that recovered in the case. The examiner will look at the test-fired cartridge cases and the recovered cartridge cases simultaneously using an instrument called a comparison microscope, which is necessary to overlay the images of the two shell casings. First put into use in 1925, the comparison microscope allows the examiner to

> compare the tiny markings left on the two cartridge cases. In theory, if the test cartridges and recovered cartridges were fired from the same gun, the examiner would see sufficient patterns of matching marks, supposedly leading to "a result as conclusive as fingerprints."

*Monteiro*, 407 F. Supp. 2d at 361; *see* JULIAN S. HATCHER, FRANK J. JURY & JAC WELLER, FIREARMS INVESTIGATION, IDENTIFICATION, AND EVIDENCE 15 (2d ed. 1957) (identified in *Monteiro*, 407 F. Supp. 2d at 368 as "the leading treatise in the field"). The examiner may reach one of three conclusions:

> The examiner can make: (1) an "identification" of the components, concluding that they came from the same source; (2) an "elimination" of the components, concluding that they did not come from the same source; and (3) "inconclusive," meaning that there is not enough evidence to identify whether the components either do or do not come from the same source. In the parlance of firearm examiners, if there is sufficient agreement to make an identification, a firearm examiner often states that the chance that another firearm could have made the mark is a "practical impossibility."

*Diaz*, 2007 WL 485967, at *3.

"A perfect correspondence between the lines on a test-fired cartridge and the evidence recovered from the scene is impossible; in the real world, there is no such thing as a 'perfect match.'" *Monteiro*, 407 F. Supp. 2d at 362 (quoting Alfred A. Biasotti, *A Statistical Study of the Individual Characteristics of Fired Bullets*, 4 J. FORENSIC SCI. 34, 44 (1959) ("Biasotti: 1959") (noting the "erroneous conception of a 'perfect match' which is actually only a theoretical possibility and a practical impossibility")). Indeed, Biasotti's 1959 study revealed that "only 21 38 percent of the marks will match up on bullets fired from the same gun." *Id.* at 362. The significance of that figure comes to light when it is noted that a correspondence between 15-20 percent of the marks of "bullets fired by two different .38 special Smith & Wesson revolvers of the same make and model" has been observed. *Id.*; *see Diaz*, 2007 WL 485967, at *12 ("According to Schwartz, Biasotti found that there was a 15-24% overlap in matching striae between bullets fired from different guns.").

Thus, according to the AFTE, a match exists "when the unique surface contours of two toolmarks are in 'sufficient agreement.'" *Monteiro*, 407 F. Supp. 2d at 363 (quoting *Theory of Identification*, 30 AFTE J. 86, 86 (1998) ("*AFTE Theory*")); *see Glynn*, 578 F. Supp. 2d at 571-72; NRC Forensic Science Report at 153. "Sufficient agreement" is defined in terms of "'the significant duplication of random toolmarks,'" and "'[a]greement is significant when it exceeds the best agreement demonstrated between tool marks known to have been produced by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool.'" *Monteiro*, 407 F. Supp. 2d at 363 (quoting *AFTE Theory* at 86). Put another way, among those who subscribe to the AFTE theory of toolmark identification, "[t]he statement that 'sufficient agreement' exists between two toolmarks means that the likelihood that another tool could have made the mark is so remote as to be considered a practical impossibility." *Id.* (quoting *AFTE Theory* at 86); *see* Nichols, *supra*, at 589.

The AFTE acknowledges that "'the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner's training and experience.'" *Monteiro*, 407 F. Supp. 2d at 363 (quoting *AFTE Theory* at 86). At the hearing, Sgt. Ensor agreed that the interpretation of observed characteristics by a toolmark examiner is a subjective process. Hr'g Tr. 10/26/09. Agreeing that it "is largely a subjective determination," *Monteiro*, 407 F. Supp. 2d at 355, the *Monteiro* court elaborated: "This conclusion is not based on any quantitative standard for how many striations or marks need to match or line up. Instead, it is based on a holistic assessment of what the examiner sees." *Id.* at 364. In *Glynn*, the court observed that the requirement that "sufficient agreement" must exist for an examiner to declare a match "is

inherently vague," and "ballistics opinions are significantly subjective."[10] 578 F. Supp. 2d at 572; *cf. Diaz*, 2007 WL 485967, at *1, 8 ("the standards and criteria for traditional pattern matching are subjective," but "it is the subjective judgment of trained professionals with a keen practiced eye for discerning the extent of matching patterns"). The subjective evaluation leaves substantial latitude in reaching conclusions.[11]Indeed, the AFTE's most ardent supporter, Ronald Nichols of the Bureau of Alcohol, Tobacco, Firearms and Explosives Laboratory Services ("ATF Bureau"), San Francisco, acknowledges the subjective component of toolmark examiners undertaking to discern "sufficient agreement" in a toolmark identification, stating that "there is no universal agreement as to how much correspondence exceeds the best-known nonmatching situation." Nichols, *supra*, at 589.

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[10]The term "ballistics" is a misnomer if used to describe bullet or cartridge identification. "Ballistics is the study of flying projectiles, including bullets. Toolmark analysis, the technique used in this case, involves the study of marks made by tools, such as the marks a gun imprints on bullets or shell casings." *United States v. Green*, 405 F. Supp. 2d 104, 118 (D. Mass. 2005).

[11] Because the traditional approach of pattern matching lacks an objective standard, some firearms examiners rely instead on an approach involving consecutively matching striae ("CMS"). *Monteiro*, 407 F. Supp. 2d at 370. "CMS is an attempt to eliminate some of the subjectivity of firearms identification by using an 'objective' consideration of 'matching striae' to "add some quantification to an examination so that there is some numerical and statistical data to support an examiner's conclusion of an identification." *Diaz*, 2007 WL 485967, at *3. Under CMS, examiners look at "runs" of striae, i.e., groups of closely aligned striae on a bullet, and they consider the number of consecutive striae that match between bullets. *Monteiro*, 407 F. Supp. 2d at 370. (CMS is not applied to cartridge casings. *Diaz*, 2007 WL 485967, at *3.) Correspondence between one 6-line run of striae or two 3-line runs of striae permits an identification. *Monteiro*, 407 F. Supp. 2d at 370. CMS analysis has yet to be adopted by a majority of toolmark examiners, however. "Although CMS is a widely accepted protocol which has been scientifically validated, it is not the predominant standard in the field according to AFTE." *Id.* Further, "[t]o the critics, CMS necessarily involves some subjectivity" because an examiner must "count points of identification and . . . different examiners might count points differently." *Diaz*, 2007 WL 485967, at *12. Sgt. Ensor testified that CMS was not used as a method of making the identification at issue in this case, and that CMS is not generally used by most firearms toolmark examiners. Hr'g Tr. 10/26/09.

In an effort to bridge the gap in this subjective process to bolster findings of "sufficient agreement," the AFTE "established standards for intellectual rigor" and accepted methodology mandate (1) the "documentation of the reasons for concluding there is a match" in a particular examination (including, where appropriate, diagrams, photographs or written descriptions), and (2) the "peer review" (more accurately viewed as obtaining a second opinion from another qualified firearms and toolmark examiner on a match that has been found) of the primary examiner's conclusion by a second examiner. *See Monteiro*, 407 F. Supp. 2d at 355; *Diaz*, 2007 WL 485967, at *5; Hatcher, *supra*, at 383, 445. The AFTE standard provides:

> The case record must contain documentation of the observations that serve as the basis for a reported conclusion. Laboratories are afforded latitude in establishing how this should be accomplished. At a minimum, the documentation must include interpretable depictions or descriptions of the agreement or disagreement of individual and/or class characteristics to the extent that another qualified firearm and toolmark examiner, without the benefit of the evidence itself, can review the case record, understand what was compared, and evaluate why the examiner arrived at the reported conclusion. . . . The case record must clearly describe or label what items are depicted.

*Standardization of Comparison Documentation*, *supra*, at 72-73. Sgt. Ensor testified that photographs suffice for "interpretable depictions or descriptions of the agreement." Hr'g Tr. 10/26/09.

Indeed, when, as with firearms toolmark identification, admissibility of the examiner's opinion as to the existence of a match is predicated on the examiner's experience, it is essential that the examiner provide a sufficient explanation for the basis of the opinion. As noted by the Advisory Committee Note to Fed. R. Evid. 702:

> If the witness is relying solely or primarily on experience, then the witness must explain how that experience leads to the conclusion reached, why that

> experience is a sufficient basis for the opinion, and how that experience is reliably applied to the facts. The trial court's gatekeeping function requires more than simply "taking the expert's word for it."

The twin requirements of adequate documentation and peer review of the primary examiner's results are said to "ensure the reliability of the expert's results and the testability of the opinion." *Monteiro*, 407 F. Supp. 2d at 355; *see United States v. Crisp*, 324 F.3d 261, 269 (4th Cir. 2003) (citing "peer review . . . and double checking" among factors establishing "uniform standards" and weighing in favor of admission of fingerprint evidence as reliable). Without them, courts that have gone the farthest in undertaking an analysis of the reliability of firearms toolmark identification methodology have been reluctant to admit such evidence. *See, e.g.*, *Monteiro*, 407 F. Supp. 2d at 374 (excluding opinions of firearms examiner who failed to document the basis for his findings, and failed to subject them to peer review).

> In the words of a firearms toolmark examiner:
>
> [F]or our work to be valid, it must be verifiable to other examiners. This means that other examiners must be able to repeat the work and come to the same conclusions. Therefore, the data that we gather should provide a well-defined "roadmap" as to what experiments we performed to answer the question(s) posed, what data was gathered, and a clear demonstration of the evidence from which we supported our conclusion(s). This mechanism of communication among scientists is a substantial part of the process of verification.

*Id.* at 368 (quoting Bruce Moran, *Photo Documentation of Toolmark Identifications-An Argument in Support*, 35 AFTE J. 174, 181 (2003) and noting that the Government's expert, an operations officer for the forensic laboratories at the ATF Bureau, concurred); *see* AMERICAN SOCIETY OF CRIME LABORATORY DIRECTORS, LABORATORY ACCREDITATION BOARD MANUAL 29 (1997) (stating that "documentation to support conclusions must be such that in the absence of the examiner, another competent examiner or supervisor could evaluate what was done and

interpret the data"); Hatcher, *supra*, at 445 (stating that "firearms expert must not only do his work meticulously, accurately, and efficiently; he must also report his findings in the same manner"). Sgt. Ensor acknowledged during his testimony that the documentation of an examiner's findings as well as the review of match results by another examiner were essential components of the proper methodology required by the AFTE theory.

**B. Legal Framework for Determining the Admissibility of Toolmark Identification Evidence**

The Federal Rules of Evidence charge the district court with determining "[p]reliminary questions concerning the qualification of a person to be a witness, the existence of a privilege, or the admissibility of evidence," Fed. R. Evid. 104(a), such as the question of admissibility under Fed. R. Evid. 702. The Court must "ensur[e] that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand." *Daubert v. Merrell Dow Pharms.*, 509 U.S. 579, 597 (1993). Rule 702 provides indicia of reliability for the district court to consider: "(1) [whether] the testimony is based upon sufficient facts or data, (2) [whether] the testimony is the product of reliable principles and methods, and (3) [whether] the witness has applied the principles and methods reliably to the facts of the case." To be admissible under Rule 702, in addition to being reliable, testimony must be relevant, helpful, and "fit":

> Expert testimony which does not relate to any issue in the case is not relevant and, ergo, non-helpful. An additional consideration under Rule 702—and another aspect of relevancy—is whether expert testimony proffered in the case is sufficiently tied to the facts of the case that it will aid the jury in resolving a factual dispute. The consideration has been aptly described . . . as one of "fit."

*Daubert*, 509 U.S. at 591.

As explained in *Daubert*, a district court assesses whether proffered scientific, specialized, or technical evidence meets the requirements of relevance, reliability, helpfulness, and fit by considering five non-exclusive factors: (1) "whether a theory or technique . . . can be (and has been) tested"; (2) "whether the theory or technique has been subjected to peer review

and publication"; (3) "the known or potential rate of error"; (4) "the existence and maintenance of standards controlling the technique's operation"; and (5) whether the theory or technique has gained "'general acceptance'" in the "relevant scientific community." *Id.* at 593-94 (citation omitted). However, the Supreme Court emphasized that the inquiry was "flexible," with a "focus . . . on principles and methodology, not on the conclusions that they generate." *Id.* at 594-95; *see Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 141 (1999) ("*Daubert's* list of specific factors neither necessarily nor exclusively applies to all experts or in every case."). Also, "while the basic requirements of reliability—as they are now articulated in Rule 702—apply across the board to all expert testimony, the more particular standards for scientific evidence need not be met when the testimony offered does not purport to be 'science.'" *Glynn*, 578 F. Supp. 2d at 570 (citing *Kumho Tire*, 526 U.S. at 151-52).

The *Daubert* factors apply to established and novel theories and techniques alike, although "well-established propositions are less likely to be challenged than those that are novel, and they are more handily defended." *Daubert*, 509 U.S. at 592 n.11. Nonetheless, federal courts, almost without exception, have admitted toolmark evidence, often without applying the *Daubert* factors. *See Glynn*, 578 F. Supp. 2d at 569 ("[F]or many decades ballistics testimony was accepted almost without question in most federal courts in the United States."); *Monteiro*, 407 F. Supp. 2d at 364 (characterizing prior admissions of toolmark identification testimony as "semi-automatic," although ruling that a particular examiner could not testify for failure to document his findings or have his conclusions reviewed); *United States v. Santiago*, 199 F. Supp.

2d 101, 111 (S.D.N.Y. 2002) (noting that the "Court has not found a single case in [the Second]

Circuit that would suggest that the entire field of ballistics identification is unreliable"; declaring that "the Supreme Court's decisions in *Daubert* and *Kumho Tire*, did not call this entire field of expert analysis into question"). *See also United States v. Hicks*, 389 F.3d 514, 526 (5th Cir. 2004) ("[T]he matching of spent shell casings to the weapon that fired them has been a recognized method of ballistics testing in this circuit for decades."); *Taylor,* 2009 WL 3347485, at *9 (concluding that "firearms identification testimony is admissible under Rule 702 and *Daubert*");[12]United States v. Pugh, No. 08-cr-00130, 2009 WL 2928757, at *9-10 (S.D. Miss. 2009) (concluding that expert testimony on firearm toolmark identification was properly admitted because "[m]atching spent shell casings to the weapon that fired them is a recognized method of ballistics testing" and "firearm comparison testing has widespread acceptance in [the Fifth] Circuit"); *Diaz*, 2007 WL 485967, at *5 (Firearm toolmark identification testimony "'is admissible in every American jurisdiction. At least 37 jurisdictions have approved it by appellate opinion.' . . . No reported decision has ever excluded firearms-identification expert testimony under *Daubert.*"); *United States v. Foster*, 300 F. Supp. 2d 375 (D. Md. 2004) (noting "the general reliability of the science of ballistics"; that "[b]allistics evidence has been accepted in criminal cases for many years"; and that "[i]n the years since *Daubert*, numerous cases have

[12] In another Memorandum Opinion and Order issued in *United States v. Taylor*, No. CR 07-1244 (D.N.M. Sept. 30, 2009) (unpublished), the court granted the Government's motion to exclude Schwartz's expert testimony at trial (while allowing it at the hearing) because the court found that Professor Schwartz was "not a firearms examiner" and "not qualified by knowledge, skill, training, education, or any other means to give opinion testimony in which she disagrees (or agrees, for that matter) with the specific conclusions of the Government's firearms examiner." Slip op. at 5. Further, it "seriously question[ed] the reliability of her methodology." *Id.* at 13. Also, noting that it was not aware of "any case in which Dr. Schwartz was allowed to testify as an expert in front of a jury at trial," the court found that her trial testimony "would not be very helpful to the jury" and "would very likely confuse the jury." *Id.* at 12.

confirmed the reliability of ballistics identification"). *Cf. United States v. Green*, 405 F. Supp. 2d 104, 108 (D. Mass. 2005) (admitting evidence despite "serious reservations" because "*every single court* post-*Daubert* has admitted this testimony, sometimes without any searching review") (emphasis in *Green*). *But see Sexton v. State*, 93 S.W.3d 96, 101 (Tex. Crim. App. Ct. 2002) (concluding that district court erred in allowing testimony regarding toolmark identification of *unfired* cartridge casings because government failed to establish reliability, even though "underlying theory of toolmark examination could be reliable in a given case"); *Ramirez v. State*, 810 So. 2d 836, 849 (Fla. 2001) (finding inadmissible under *Frye* expert toolmark testimony identifying match with "absolute certainty" but lacking "the hallmarks of acceptability that apply in the relevant scientific community to this type of evidence").

Recent cases reflect concerns about the admissibility of firearm toolmark identification testimony. In *United States v. Williams*, 506 F.3d 151 (2d Cir. 2007), while concluding that the Government's firearms identification expert's methodology "satisfied" *Daubert*, the Second Circuit cautioned that its opinion should not "be taken as saying that any proffered ballistic expert should be routinely admitted." *Id.* at 161. It noted that *Daubert* did not "'grandfather' or protect from *Daubert* scrutiny evidence that had previously been admitted under *Frye* [*v. United States*, 293 F. 1013 (1923)]." *Id.* at 162. The *Williams* Court explained that past acceptance does not render expert testimony admissible; rather, "expert testimony long assumed reliable before Rule 702 must nonetheless be subject to the careful examination that *Daubert* and *Kumho Tire* require." *Id.* Given the publication of the NRC Forensic Science Report in 2009 and the NRC Ballistic Imaging Report in 2008—two reports (discussed *infra*) which I find to be particularly credible in evaluating the scientific status, *vel non*, of firearms toolmark identification methodology— I find particularly compelling the caveat expressed by the *Williams*

Court not to "grandfather" admissibility of evidence merely because it has been universally admitted in the past.

In *Green*, 405 F. Supp. 2d 104, the court also acknowledged that district courts are "obliged to critically evaluate toolmark and ballistics evidence, even though it has been accepted for years pre-*Kumho*," because failure "to do so would be equivalent to 'grandfathering old irrationality.'" *Id*. at 118 (footnote and citation omitted). The *Green* court warned: "The more courts admit this type of toolmark evidence without requiring documentation, proficiency testing, or evidence of reliability, the more sloppy practices will endure; we should require more." *Id.* at 109. Further, it observed that "recent reexaminations of relatively established forensic testimony have produced striking results," such as that "forensic testing errors were responsible for wrongful convictions in 63%" of the cases in one study. *Id.* at 109 n.6.

Nor have the courts been the only institution to acknowledge the growing concern regarding the reliability of long-accepted forensic methodology. In 2006, pursuant to a Congressional mandate, the National Academy of Sciences established a committee "'to conduct